VOCODYMPLUS

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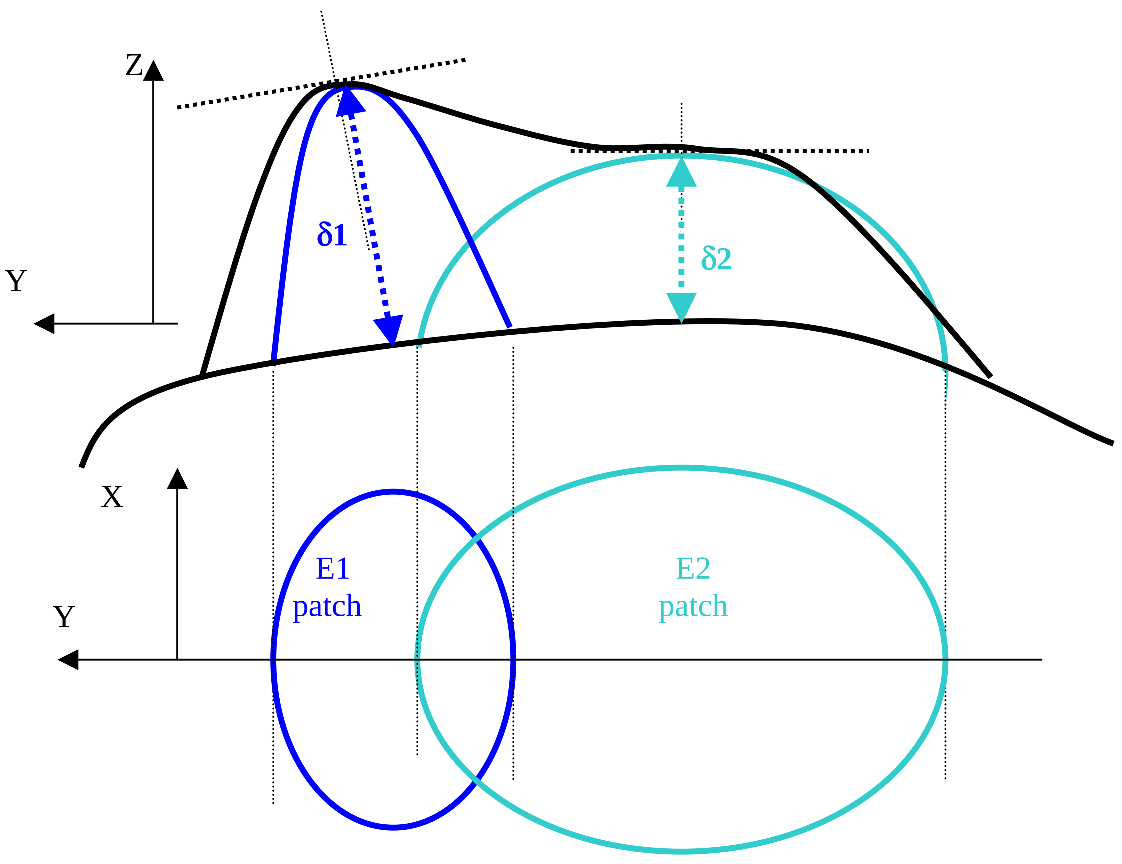
VOCODYMPLUS is an association of **VOCODYM** with a new Wheel/Rail contact code **OCREC** : **O**nline **C**alculation of **R**ailway **E**lastic **C**ontacts.

VOCODYM is used in railway industry and belongs to SNCF and INRETS.

Present new "**OCREC**" contact code was developed (J.P. Pascal) in the frame of Hertz theory of elasticity for elliptic contacts [2] and Kalker theory for rolling contact friction [1]. Non-elliptic patches are modeled as a sum of elliptic ones [4-6]. The approximation due to overlapping patches – see figure - has been studied and errors found smaller than 10% with respect to FEM calculations [3].



Interpenetrations δ1, δ2, used to calculate patches, are distances between un-deformed profiles at locations where both profiles have the same normal. Note that patches E1 and E2 are not in the same plane and that attached normal forces have proper directions (which is not the case if indentation is reduced with respect to a common plane, as is in ref [3])

"Online" calculation means that there is no pre-processed contact table and that each time step of the dynamical code is made of three successive parts:

- a search for all possible contact locations all over wheels and rails profiles taking into account new data of this step, including track geometry
- a calculation of normal distances between profiles at these locations and, if there are indentations, calculation of corresponding elastic normal forces and then tangential forces [1-3].
- integration of dynamical equations.

The goal has been to improve the programming so as to gain both acceptable CPU times and effective accuracy.

Files formats are kept in the environment of Vocodym codes so as to be compatible with existing vehicle models as well as with wheels and rails profiles.

It works with a constant time step (dt<1E-4s) and uses as integration solver a third order Taylor algorithm.

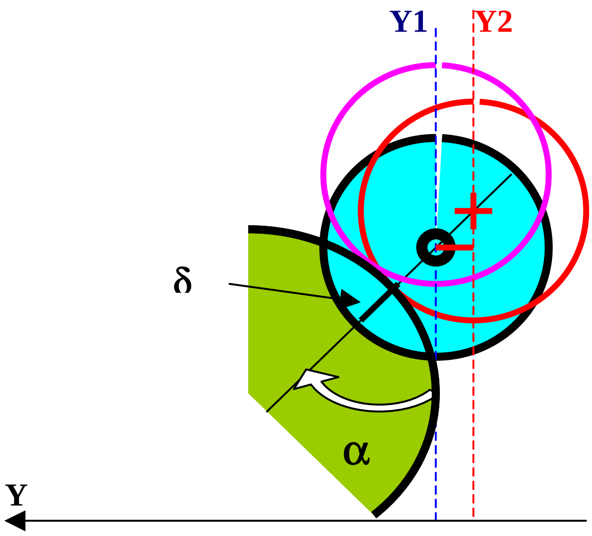
Simulating difficult cases, with many flanging situations, although producing more detailed and proper results, it allows shorter computing times than using constraint algorithms.

Location Issue for Hertzian Contacts

Contact assumption fits Hertz theory, i.e. un-deformed profiles curvatures are assumed to be constant along the patch and are chosen at the patch middle (see upper figure). Looking for location of these middles, rigid profiles are used, i.e. locations are found with no indentation.
Doing this, it is usual to take the lateral displacement Y of one profile with respect to the other as input parameter. During elastic dynamical simulations it is accepted that both profiles can interfere with an indentation δ (blue body at abscissa Y1 interfering with the green body in the figure below). Normal contact force depends on δ and profiles curvatures.
If the contact location is looked for using this Y1 abscissa, it'll be found too high (magenta circle), thus, in order to find the proper contact angle using rigid profiles (red circle), it is necessary to use a corrected Y2 abscissa such as

$$\mathbf{Y2 = Y1 - \delta \, . \, \sin(\alpha)}$$

In principle iterations should be necessary to find the corrected angle and location. In practice, due to very small time steps necessary to integrate dynamical equations, it is possible to use δ and α of previous step.



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